PATENT SPECIFICATION

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(19)

(54) A PISTON FOR INTERNAL COMBUSTION ENGINES

(71) We, KARL SCHMIDT GMBH, a body corporate organised under the Laws of Germany, of 8/12 Christian-Schmidt-Strasse, 7107 Neckarsulm, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a piston for an internal combustion engine, particularly a piston made of a light metal.

It is well understood that the gas pressures acting on the crown of a piston when the piston is in use in an internal combustion engine are transmitted from the combustion chamber to the gudgeon pin through the bosses. Since the oscillating motions of the connecting rod of the piston require the gudgeon pin to rotate in the bosses, the latter must be thought of as being high load bearings. The forces acting on the gudgeon pin cyclically bend the pin and in addition they squeeze it into ovality. This applies tensile, compressive and flexural stresses to the bosses in horizontal and vertical planes. Owing to the bending of the pin, the stress in the bosses increases towards the inner end of the boss. With increasing loads on the piston, the shape of the bores in the piston bosses therefore requires attention. This is of particular importance because for reasons of weight, despite rising piston loads, the weight of the pin should not be increased but if possible even decreased to allow for the greater inertial forces that simultaneously arise at higher piston speeds.

For instance in W.—D. Bensinger and A. Meyer "Kolben, Pleuel — und Kurbelwelle bei schnellaufenden Verbrennungsmotoren" (Piston, Con.Rod and Crankshaft in High Speed I.C. Engines), Berlin/Goettingen/Heidelberg 1961, on page 10, it is stated that peak stresses can be reduced at the inner edge of the boss by designing the edge at the radius of 1 mm. or by imparting sufficient elasticity to the bosses in this region to enable them to some extent to participate in the bending movements of the gudgeon pin without causing the piston material to be overstressed. It is further proposed to give the inside edges of the bosses a divergent conical taper of about 1 : 100.

In this context, it has also been proposed to shrink rectangular reinforcing rings around the external periphery of the gudgeon pin bosses. Since the part of the boss which is contained within the shrunk reinforcing ring expands less during operation than the remainder, the bore in the boss is reduced on the side of the shrunk ring to compensate this difference in expansion and thereby in the operating state to provide a cylindrical bore similar to that in the unreinforced boss.

Despite the steps that have already been proposed, it has not been successfully possible substantially to reduce the stress which, in the bores of the gudgeon pin bosses, progressively increases from the outside inwards and at the same time to improve the uniformity of lubrication, to prevent seizing and to reduce the noise level.

According to the present invention there is provided a piston for an internal combustion engine, wherein bores which are formed in the gudgeon pin bosses each have a generating line that is curved to give rise to a bore which, towards the inner end of the boss, diverges conically or is flared.

The shape of the bores in the gudgeon pin bosses are designed so that, at maximum loads, the stresses existing in the interior of the bosses are distributed substantially evenly over the entire length in contact with the gudgeon pin, thereby to prevent the occurrence of fractures. It is also possible to ensure a satisfactory and even development of the wedge-shaped lubricating film with a view to reducing the pressure in the gudgeon pin bearing and to preventing the pin from seizing.

In order to compensate for flexing of the

gudgeon pin under maximum load, the bores in the bosses thus have a camber due to the curved shape of their generating line.

In the region of the internal end of the bosses, the generating lines give rise to a relatively pronounced conical divergence or flare to avoid the generation of high loads in this region; in the middle of the bores they are slightly curved. Near the outside of the bores, the generating lines may have a gentle divergent bend or they may be linearly or slightly conically flared according to the flexure experienced by the gudgeon pin.

For some cases of loading, it is sufficient for the generating lines of the bores in the bosses to provide a conical flare, preferably in the form of multiple cones, particularly two or three cones, to the inside edge of the bosses.

In one preferred embodiment of the present piston, the bores in the bosses have a cross-section that is not round but oval, the minor axis of the oval being parallel to the longitudinal axis of the piston. A piston having a bearing for the reception of a piston pin, wherein bosses in the piston which are to receive the piston pin are elliptical throughout their length, is described and claimed in the Specification of our Patent No. 1,206,878.

The ovality of the bore of the boss conforms with the deformation into ovality of the gudgeon pin so that the load distribution inside the boss is more uniform. Another advantage of the ovality of the bore of gudgeon pin bosses is that, in the non-load-bearing zone normal to the piston axis, lubricant pockets are formed between the boss and the pin.

The ovality of the bores in gudgeon pin bosses, which may have an elliptical form, may, if desired, be suitably corrected to provide a maximum load bearing surface.

However, the ovality of the bore can be made to exceed the oval deformation experienced by the pin and oil pockets can be thus created between the bore and the pin. These are very useful for assisting the generation of good lubricant wedges, besides providing some compensation for the clearance that arises between differentially expanding materials of piston and gudgeon pin.

In order to prevent the flexural deformation of the gudgeon pin in the region of the considerably flared inside end of the bore from being excessive, it is desirable so to dispose the bores inside the bosses that their common axis is slightly arched towards the piston crown in conformity with the flexure of the gudgeon pin under operating conditions. In the unloaded state, the gudgeon pin will then bear against the inside of the bore roughly in the middle. In such a configuration, the bearing surface between gudgeon pin and boss is relatively large, even at fractional loads, and assumes its maximum as the load rises.

In order to enable the invention to be more readily understood, reference will now be made to the accompanying drawings, which illustrate diagrammatically and by way of example some embodiments thereof, and in which:—

Fig. 1 is a longitudinal section of a part of a piston,

Fig. 2 is an enlarged detail of part of the section shown in Fig. 1,

Fig. 3 shows the shape of bore in a gudgeon pin boss, and

Fig. 4 is a view similar to Fig. 1 of another piston.

Referring now to Fig. 1, there is shown part of a piston 1 in which the generating lines 2 of cross-sectionally circular bores 3 in the gudgeon pin of the piston bosses are shaped to form a cambered surface in each bore, as more clearly shown in Fig. 2, where the part 4 in Fig. 1 is shown on a larger scale. It will be seen from Fig. 2 that the generating line 2 gives rise to a relatively marked divergent flare at the inner ends of the bores, whereas in the middle it is slightly curved and at the outer end of the boss defines a slightly divergent opening.

Fig. 3 shows a cross-sectionally oval bore 5 in a boss in which the ovality is corrected so that bearing surfaces are formed in the region of the points of intersection 6 with the minor axis 7 and lubricating pockets in the region of the points of intersection 8 with the major axis 9.

Fig. 4 is a view, similar to Fig. 1, of a piston 10 in which the bores 11 in the bosses are so disposed that their common axis 12 is slightly arched towards the piston crown in conformity with the flexure, in use, of a gudgeon pin 13, and in which the axis 14 of the gudgeon pin coincides with the axis 12 of the bores 11 at least in the region of the outer ends of the bosses.

WHAT WE CLAIM IS:—

1. A piston for an internal combustion engine, wherein bores which are formed in the gudgeon pin bosses each have a generating line that is curved to give rise to a bore which, towards the inner end of the boss, diverges conically or is flared.

2. A piston as claimed in Claim 1, wherein the generating line of each bore is curved in the middle.

3. A piston as claimed in Claim 1 or 2, wherein the bore diverges conically in the form of several cones.

4. A piston as claimed in Claim 3, wherein the bore diverges conically in the form of two or three cones.

5. A piston as claimed in Claim 1 or 2,

wherein the generating line of each bore gives rise to a curvilinear flare at the outer end of the boss.

6. A piston as claimed in any one of Claims 1 to 5, wherein the generating line of each bore is straight near the outer end of the boss.

7. A piston as claimed in any one of Claims 1 to 5, wherein the generating line of the bore gives rise to a conical flare at the outer end of the boss.

8. A piston as claimed in any one of Claims 1 to 7, wherein each bore in the boss has an oval cross-section, the minor axis of the oval being parallel to the longitudinal axis of the piston.

9. A piston as claimed in any one of Claims 1 to 8, wherein the bores in the bosses are so disposed that their common axis is arched towards the piston crown in conformity with the flexural deformation of the gudgeon pin under operating conditions.

10. A piston as claimed in any one of Claims 1 to 9, wherein the piston is made of a light metal.

11. A piston for an internal combustion engine substantially as hereinbefore described with reference to Figs. 1 and 2 or Fig. 3 or Fig. 4 of the accompanying drawings.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

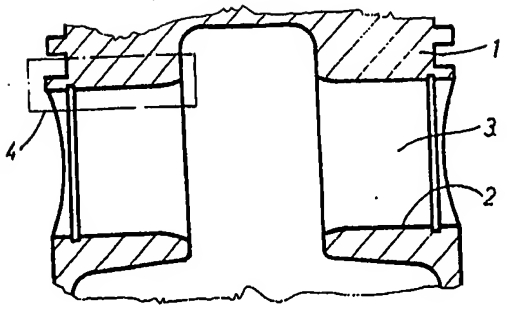

FIG. 2

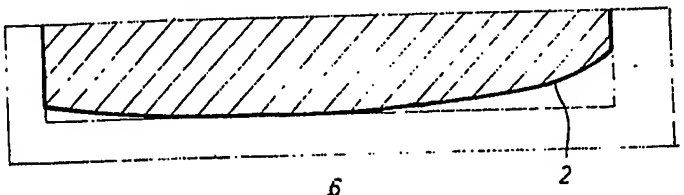

FIG. 3

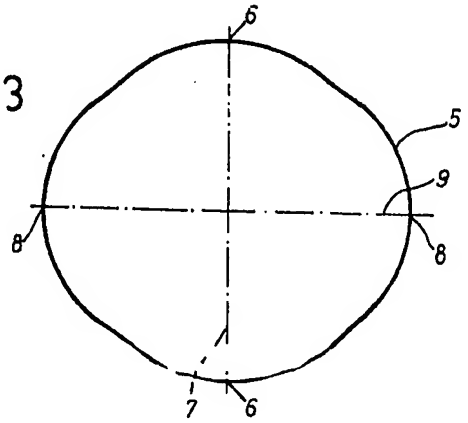

FIG. 4